Internet for Teaching and Learning Introductory Health Informatics

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Internet resources seem attractive for teaching and learning. But are they usable and useful in their present form? We explored Internet, in particular its World Wide Web (WWW) resources, in a course on "Medical Methodology" (HINF270) for students of health information science. This course offers a systematic overview of the methodological principles of clinical care. Its broad scope and low depth makes this course a reasonable model to explore the limits of WWW resources. During the course, students wrote summaries of individual lectures. After critiquing and appropriate corrections, the texts were edited with Hypertext Mark-up Language (HTML) and augmented with links to WWW resources. Grading based on the papers, on their improvements through HTML and WWW, and on the provision of information on the search experience were incentives to use WWW. A formal questionnaire, administered on-line on a voluntary basis, concluded the investigation. Results show: 1) Even under considerable pressure to use WWW, libraries remain the reference source of choice for research; 2) Internet provides entertainment appeal even though practical utility is currently limited; 3) Technological proficiency with HTML and search engines is perceived as an asset; 4) Varying availability of Internet resources, uncertain and varying quality of sources, and limited specificity of research results are the major disadvantages of WWW. The teaching implications of these findings are discussed.

INTRODUCTION

The World Wide Web (WWW) is a comparatively new medium, a form of Internet communication which allows users to access documents containing text, images, sound or video sequences, and clickable hyperlinks to other documents of this type[1-3]. It is extremely popular with Internet users, with over twelve thousand hosts (ninety percent created in the last six months).[4] Already it has been seized upon as an educational resource[5,6], with correspondence courses, reference guides and scholarly manuscripts intermixed with reams of promotional and hobbyist publications. As use of the World Wide WWW continues to grow, it is time for a critical examination of its potential as a learning and teaching complement. We explored to what extent these resources are usable and useful for education and research in their current form, in the context of an undergraduate program in health informatics.

MATERIALS & METHODS

The issue was explored in the context of the course "Medical Methodology" (HINF270) taught in the second year of the undergraduate program of Health Information Science at the University of Victoria. The course gives a systematized overview of clinical methodology for non clinicians, with emphasis on the requirements of informatics. The covered material is varied and of limited depth. Coverage includes the epistemologic basis of health and disease concepts, clinical and paraclinical processes of diagnostics and therapy (overviews of clinical pathology, electrophysiology, imaging; principles of drug, surgical and radiation therapy), principles of coding and classification systems, measures of objectivity and validity, errors, their detection and correction. During the spring of 1995 a class of 22 students, 8 male and 14 female, was enrolled. About half of the students had previous degrees and/or careers.

Students were assigned to take notes of up to two lectures each. The corrected and approved papers were put on WWW, edited in HTML and augmented with hyperlinks to relevant documents elsewhere on WWW. For this, students had access to a laboratory equipped with ten RS6000 machines during formal lab sessions and on a drop in basis, 12 hours a day, seven days a week. Formal instruction included an introduction to Internet, search engines and HTML. The class had been exposed to WWW in the previous semester. Five students said they had used it more than twice a month. One of these had used it for three months, two for two months and two had used it for less than one month.

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Students had to report 480 minutes spent on the Internet to pass the course and were marked on their papers, the reports on their search experience, and their final augmented document (and a mid term and final exam). On-line search reports recorded the purpose of the student's session and the attainment of their goals. Students' questions and actions were observed both during and outside the lab sessions. A voluntary online questionnaire was administered at the end of the course. It contained forty-nine open-ended and closed questions, to be answered in free text and on a five point Likert scale respectively.

RESULTS

General Observations

All students completed their assignments, some with not only superficially impressive but highly valid documents, which attest to their authors' resourcefulness. The quality of the initial papers varied widely, in some instances surpassing the original lecture substantially and being acceptable without change, in other instances requiring up to five major revisions. Not unexpectedly, this range of competence affected the success of Internet searches, as well as the quality of the hyper links provided. Links were not always adequate, even if students thought they had located relevant material.

Students reported researching their topics, on average, for 747 minutes on WWW (minimum required 480, lowest reported 330 minutes, highest 1650). However, many students said they under-reported their time. Students submitted 6.6 reports, on average, over the semester (range 2 to 12).

On the whole, students were enthusiastic about what they could find on WWW. However, they often ran into difficulties in getting access to promising sites. Problems included Internet congestion, servers not being found, and, particularly frustrating, servers which offered homepages and some resources to the public, but restricted access to what promised to be more in-depth information to selected audiences. In some cases, resources available early in the semester were removed or made private by the time the students' assignments were due. In others, a splendid table of contents was followed by a promise of "contents to come." Many students were frustrated finding resources, particularly those researching more esoteric topics than "nursing" or "radiology." Searching for keywords often produced many spurious results. The library often served as a recourse, both for the information needed to write the paper and for the nomenclature required to make effective use of keyword-based search engines.

Questionnaire

Seventeen of the twenty-two students in the class answered the questionnaire over the last two weeks of the course. Those who answered the questionnaire spent more time researching WWW than those who didn't (an average of 829.7 minutes, compared to the class average of 746.8 minutes), but received almost exactly the same mark (78.5% vs. 77.2%) for their search submissions.

The following data give a summary of the questionnaire results. For those questions which were answered on a Likert scale of 1-5, where 1 corresponded to strong disagreement and 5 to strong agreement, we report the average scores in brakets.

Students rated themeselves competent with computers (4.5) and net browsers (4.1), and found knowledge of HTML a assest for their work (3.7),. They felt confident with their ability to work on their research assignments in an organized fashion (3.7) but felt less sure about adequacy of their knowledge to pursue the medically oriented research topics (2.8). Most felt that it took them 2-3 weeks to feel comfortable with searching the Web. Students stated they had done their research mostly in the library (11/16 nominations) and found most of their material there (9/16 nominations). The hypertext links were found equally as useful as the contents of WWW pages themselves. If hyperlinks were followed, students were comfortable in assessing their usefulness (3.8). Some reported a tendency to terminate the transfer of material prematurely (8/15 often or very often). Students found that the links were not reliable (3.6) and that the unreliability was an impediment to their work (3.8).

Student attitudes towards WWW changed over the semester. Even initial enthusiasts reacted eventually with reserve. When asked, students reported that initially they found it fun to research WWW (4.2), but less so at the end of the course (3.9). Five decreased their rating on the respective questions, one increased it.

A considerable residual fun factor was evident nonetheless, when students were asked about their entertainment choices in their spare time at home. "Surfing the internet" ranked third with a score of

22 after "watching a video" (29) and "reading a book"(24).

The fun factor has a significant amount of distraction potential, as evidenced by the number of students who reported spending time on other topics than their original intent. It is interesting to note that this distraction factor is little affected by whether the original intent was entertainment or research:

Number of Students Reporting % of Time Spent on the Complementary Activity when Intent on

	Research	**Entertainement**
<20%	6	5
20-40%	5	6
40-60%	4	2
>60%	2	2

Even though strongly encouraged through grading incentives to actively pass on hints on relevant resources to fellow students, they reported finding and reporting these to other students only occasionally. At the receiving end, students felt they had been rarely supplied with hints from others. This may partly be due to the wide range of topics to be researched. It was not surprising therefore that the answers regarding the utility of WWW resources for the research topics were almost evenly distributed over the whole range with a mean rating of 2.5. Students felt they could rely on their judgement of the value of documents located (3.5) (a sentiment not always supported by their choices!) but found that promising titles only occasionally revealed useful material (2.9). Nonetheless they reported that they would resort to WWW in the future, even if not specifically required (3.7). The ranking of topics they would research on WWW (by number of nominations) were:

Science, Medicine & Technology	9
Entertainment, Sports	4
Current events; images; general: each	3

No conclusive answers were obtained on the question what NOT to research on WWW.

All students did use some of the search engines available on the Web, and opinion on their usefulness was divided: nine agreed (or strongly agreed) that the search engines were useful, while eight were not sure or disagreed. Many of the students were frustrated by low precision of the returns, as many documents containing the specified keywords had nothing to do with the topic sought. Students addressed this by feeding more specific words to the search engines (sometimes after broadening their vocabulary through the library), and using near-hits as starting points for WWW surfing, a more time-consuming process. Others gave up on the Web, doing their research in the library. Among search engines, WebCrawler was favoured by most (7/15 nominations), WorldWideWebWorm and JumpStation received 2 nominations each, and InfoSeek, Nikos, and AliWWW none.

When asked, "If you had to find medical methodology information on WWW in 15 minutes, how would you go about finding it?" there were thirteen suggestions to try search engines, four to try subject-oriented lists (two specified medical sites, such as Medical Matrix, while two suggested the more general Yahoo), two recommended getting synonyms to help searches, and one said "Forget it. Go to the library." When asked the same question for a search time of three hours, thirteen suggested search engines, with three saying they would follow links more deeply than if given 15 minutes, four indicated they would read more of the documents "for clues," and one said he would read related topics, hoping to find useful links. Six said they would try subject lists (two medical, four Yahoo). One person recommended using Gopher search, for their "higher volume of topic-related listings & on-line keyword searches from gopher menus," while another advised trying areas not directly related to the topic. "For example, while in a Ministry of Environment site I found information related to health issues." One said they would do research in the library before WWW. For the semester time frame, only three suggested search engines and one a subject list.

Students were then asked, "If you were to advise students in next year's HINF 270 lab, what strategy for researching their topics would you recommend to them?" Seven students recommended using the library first, in order to learn the basic knowledge and terminology of their topic; one suggested this was a more familiar way of researching. Three recommended talking to other classmates ("This was probably the most useful [method]."), two suggested surfing WWW and then planning, one recommended finding uncommon words for keyword searches, and one advised trying off-topic sites.

DISCUSSION

What do we make of these data in light of our goals of assessing the usefulness of Internet and its WWW resources for education in health informatics? What is the value of WWW as an information resource? What is its value beyond this as a catalyst for learning and as an instrument for teaching? Let us unravel these questions from the simple to the sublime.

Researching a topic on WWW has two components: 1) finding relevant information, and 2) making use of that information. Both proved to be troublesome for the students. Given the amount of effort most applied to the project and their general academic ability, this may reflect on WWW rather than its users. Finding information on WWW is more a function of its quality as a medium than that of its content. The question whether the medium is conducive to research shall therefore be addressed first.

That the students felt comfortable with WWW software (browsers) is not surprising, given their experience with computers, and their place in an applied informatics program. The fact that many felt their knowledge of HTML helped them use WWW is in accord with this but seems to leave room for interpretation. Many were seeking images to use in their assignments. They had learned how to call up images from other computers and how to download them to their machine. While satisfying, this may have not helped their actual *locating* of information. It is possible, but seems unlikely, that teaching people how to use HTML would really aid their research success on the Web.

A weak correlation between students' self assessment of competence at doing research in the library and their amount of research at the library is interesting, as it suggests that better researchers went to the richer source of information. Both the small sample size and the diversity of topics confound this observation, however. Interestingly, the length of time needed to feel comfortable on WWW does not correlate with whether more research was done in the library than on WWW. This, and the overwhelming choice of the students of the library as the more useful source of information, suggests the information they were required to find on WWW either was not there or was of inferior quality.

How well could students find the information they wanted? Here the data is also confounded by the variety of their research topics. It is interesting that the buddy system came out prominently as an aid for doing research, when students were asked to advise their future fellow students. Nonetheless, only some active offerings of hints took place among the students. This is in contrast to one of our expectations, namely that the computer lab might turn into a centre of buzzing activity, outdoing not only the traditional dusty research resources, but perhaps even the lecture halls.

Once the students found information on WWW which was relevant to their topic, it did not appear to meet their all their needs and wants. In general, students found WWW documents did not provide information in great depth, which is given as one of the reasons they turned to the library. It is also possible that the material was too deep and too specific for the level of the course without the students registering the fact as such. It is hard to imagine that an overview course as this on Medical Methodology did really require more depth than provided by the WWW resources. It may rather be that there was a gap between the level of depth provided and the level of depth sought and manageable by the students. It is, e.g., possible to access collections of CT images on rare or typical cases, without finding the mechanisms of CT imaging explained anywhere.

From the perspective of the instructor, the review of the assignments prepared by the students was revealing. The successful work was delightful. The lack of understanding at the other extreme, was, however even more enlightening. It afforded more opportunity for correction of misconceptions than ever experienced before. This effect was, of course, totally incidental to the use of WWW. While this effect could be used in augmenting teaching, it leaves the question of whether WWW did contribute to learning in an analogous fashion by itself? We noted already that the expected stimulation of cooperative learning was rudimentary at best. What about the skills in online researching, the fixation of mental images, e.g. of anatomic structures, etc.? The responses of the students suggest that a period of 4 weeks should suffice to build the former. From the results of the final exam we do not note a striking effect on the latter. It is rather telling that the students themselves expressed that they did not learn about their topic from researching on the WWW. Whether this is due to the poor quality of

information or its unavailability is unknown. Oddly, these sentiments did not prevent students from saying they would use WWW for future research assignments, even if it was not required of them. In particular, students indicated they would look to WWW for topics in the field of science, medicine and technology, which is not surprising, given that the Internet originated from such interests.

In summary then, our experience exposes WWW in its present form as a nice complement to conventional teaching and larning, with traces of fun, and a reasonable incentive to improve technical skills. It is not yet a break through and will require much more conscientious development and exploration.

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